

NEW CHEMOSTERILANTS FOR BOLL WEEVILS

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NEW CHEMOSTERILANTS FOR BOLL WEEVILS

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ABSTRACT

Thirty-two of 295 compounds tested were effective chemosterilants on mixed-sex boll weevil groups when the compounds were fed for 3 days in an adult diet. Fourteen of the 32 chemosterilants were aziridinyl compounds. When the treated weevils were outcrossed to normal male and female weevils, the following compounds were the most effective: *N,N'*-1,5-naphthylenebis-(1-aziridinecarboxamide) (ENT-50664); 1,1'-methylenebis(aziridine) (ENT-50752); *P*-(1-aziridinyl)-*N,N,N,N'*-tetramethylphosphonic diamide (ENT-50991); butyl bis(1-aziridinyl) phosphinate (ENT-61354); *P,P*-bis(1-aziridinyl)-*N*-propylphosphinothioic amide (ENT-61580); *P,P*-bis(1-aziridinyl)-*N*-ethylphosphinothioic amide (ENT-61581); bis(1-aziridinyl) ethylphosphine sulfide (ENT-61587); 1,9-nonanediol dimethanesulfonate (ENT-26397); *N*-fluoren-2-ylacetohydroxamic acid (ENT-50466); 1-nitro-3-[(2-pyridylmethylene)amino]guanidine (ENT-52077); and *m*-(salicylidene-amino) phenol (ENT-52102).

INTRODUCTION

The Agricultural Research Service is searching for more effective chemosterilants for the boll weevil, *Anthonomus grandis* Boheman. It is especially important to find relatively nontoxic compounds that will effectively sterilize female weevils as well as males. In the event eradication of the boll weevil is attempted in all infested cotton-growing States, it will be impractical to separate sexes to release only male weevils (as has been done in pilot eradication tests).

Two hundred and ninety-five compounds were tested for chemosterilant activity and are included in this report. The compounds are aziridines, triazines, phosphoramides, nitrogen mustards, sulfonic acid esters, and other kinds.

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These types of compounds were shown to be the most effective in earlier screening programs (4, 5).³ Six compounds included in this report were previously reported (4, 5) as effective boll weevil chemosterilants: *N*-fluoren-2-ylacetohydroxamic acid (ENT-50466);⁴ ethyl bis(1-aziridinyl) phosphinate (ENT-50761); hexamethylphosphoric triamide (ENT-50882); 1,3-propanediol dimethanesulfonate (ENT-51904); *P,P*-bis(1-aziridinyl)-*N*-ethylphosphinothioic amide (ENT-61581); and *P,P*-bis(1-aziridinyl)-*N*-methylphosphinothioic amide (ENT-61585).

MATERIALS AND METHODS

The compounds used in this study were supplied by the Insect Chemosterilants Laboratory, Agricultural Environmental Quality Institute, Beltsville, Md., and by the Southern Research Institute, Birmingham, Ala. An ebony strain of

³ Italic numbers in parentheses refer to items in "Literature Cited" at the end of this publication.

⁴ Numbers prefixed with ENT are assigned to new compounds by Agricultural Research Service, Beltsville, Md. The ENT prefix was replaced with the prefix AI3 in 1972, but the compound numbers remained the same.

boll weevils was used in screening (1). All larval and adult diets were freshly prepared every 1 to 3 days (3, 6). It is quite possible that different weevil strains or diets would influence reproducibility of results with a given chemosterilant.

The candidate chemosterilant was weighed, dissolved in a minimum amount of water, methanol, or acetone, and then mixed into hot adult diet. The treated diet was next formed into pellets, waxed, and stored in the refrigerator at 5° to 6° C.

Chemosterilant activity and compound toxicity were determined as follows: Fifty mixed-sex, 1-day-old weevils were placed in a 7.3- by 7.3- by 2.9-cm plastic box with a screen opening and fed treated diet pellets for 3 days, after which untreated pellets were provided. Seven and fourteen days after treatment, mortality counts, indicating compound toxicity, were made, and samples of as many as 50 eggs were collected to determine sterility (indicated by egg hatch and F_1 adult emergence). Half the egg sample was held for hatch; the other half was implanted in larval plates for F_1 adult emergence. If a compound tested on mixed-sex groups of weevils (treated males mated to treated females) reduced adult emergence to one-half that of the control, the compound was retested on treated males mated to normal females and treated females mated to normal males. Thus, it could be determined if males or females or both sexes were affected by the chemical treatment (4, 5).

A 0.5% to 1% concentration of candidate chemosterilant was tried first; depending on the percentage of sterility and mortality at this level, the concentration was then increased or decreased. In some cases, there was not enough chemical available to determine the most effective concentration.

RESULTS AND DISCUSSION

Thirty-two of the 295 compounds tested on mixed-sex groups of boll weevils reduced adult F_1 emergence to 15% or less, with no more than 33% mortality of the treated parents by 7 days posttreatment. These compounds and the concentrations that were the most effective on mixed sexes are given in table 1. (Complete experimental results are given in table 3.)

Almost half the compounds effective on mixed sexes were aziridines; several other effective compounds were sulfonic acid esters or nitrogen

mustards. These compounds have proven to be very active chemosterilants on boll weevils as well as on other insect species, but they are also quite toxic (2, 4, 5).

TABLE 1.—Effective chemosterilants against mixed-sex boll weevil groups¹

Compound	Concentration (%)
Acetohydroxamic acid, <i>N</i> -fluoren-2-yl- . . .	0.4
Ammonium, 2-butynylenebis [trimethyl chloride]	0.5-0.75
2,3-Bornanedione	2
Carbamic acid, methylnitroso-, ester with 3-(<i>p</i> -hydroxyphenethyl)-1-methyl-1-nitrosourea	0.1
<i>p</i> -Cresol, α -[<i>p</i> -(<i>o</i> -methoxyphenoxy) phenyl]amino]-2,6-dinitro-	2
2-Furaldehyde, 5-nitro-, thiosemicarbazone	1
Glycine, <i>N,N</i> -bis(2-hydroxyethyl)-	0.5
Guanidine, 3-amino-1,1-dimethyl-, monohydriodide	2
Guanidine, 1-nitro-3-[(2-pyridylmethylene)amino]-	0.1-1
Hydroquinone, 2,5-di- <i>tert</i> -butyl-	0.5
Indole-2,3-dione, 1-methyl-, 3-(thiosemicarbazone)	2
Phenol, 2,4,6-tris[(ethylamino)methyl]-	0.5
Phosphine oxide, bis(1-aziridinyl)ethyl-	0.05-0.1
Phosphinic acid, bis(1-aziridinyl)-, butyl ester	0.60
Phosphinic acid, bis(1-aziridinyl)-, ethyl ester	0.1
Phosphinic acid, bis(1-aziridinyl)-, methyl ester	0.05-0.2
Phosphinic acid, bis(1-aziridinyl)-, propyl ester	0.05-0.1
Phosphinic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -(<i>o</i> -chlorophenyl)-	0.05-0.5
Phosphinic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -methyl-	0.05-0.5
Phosphinic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -phenyl-	0.05-0.5
Phosphinic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -propyl-	1
Phosphinothioic acid, bis(1-aziridinyl)-, <i>O</i> -ethyl ester	0.1
Phosphinothioic acid, bis(1-aziridinyl)-, <i>S</i> -ethyl ester	0.05-0.3
Phosphinothioic acid, bis(1-aziridinyl)-, <i>S</i> -methyl ester	0.05-0.3
Phosphinothioic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -ethyl-	0.006-0.007
Phosphinothioic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -methyl-	0.05
Phosphoric triamide, hexamethyl-	0.5
1,3-Propanediol, dimethanesulfonate	1

See footnote at end of table.

TABLE 1.—*Effective chemosterilants against mixed-sex boll weevil groups*¹—Continued

Compound	Concentration (%)
Thiazole, 2-amino-4-(<i>p</i> -nitrophenyl)-	2
Urea, 3-(5-amino-1,3,4-thiadiazol-2-yl)-1,1-dimethyl-	1
Urea, 1-(2-chloroethyl)-1-nitroso-3-(2,6-xylyl)-	0.01
Urea, 3,3'-(4-(<i>p</i> -methoxyphenyl)-1,2,4-dithiazolidine-3,5-diylidene)bis[1,1-dimethyl-2-thio-	0.05

¹ Compounds reduced adult *F*₁ emergence to 15% or less, with no more than 33% mortality of treated parents by 7 days posttreatment.

The treatments of sterile males mated to normal females or sterile females mated to normal males in which mortality was no more than 33% by 1 week posttreatment, adult *F*₁ emergence was 15% or less, and no more than 25 eggs were collected during the test period are given in table 2. (Complete experimental results are given in table 3.) Seven of the eleven most effective, least toxic compounds against males or females or both were aziridines. For example, 1,1'-methylenebis(aziridine) at 0.4% to 0.5% reduced eggs 92% below the number laid by untreated controls, while mortality of treated females was only twice that of controls by 14 days posttreatment. *P*-(1-aziridinyl)-*N,N,N,N'*-tetramethylphosphonic diamide fed to males at 0.2% reduced hatch and emergence to 4% or less in three replications, and mortality was only 42% by 2 weeks posttreatment, compared to 25% in the control. A 0.075% to 0.1% feeding of butyl bis(1-aziridinyl)phosphinate in the diet resulted in 90% to 100% sterility of males, based on adult emergence. Fecundity of treated females was reduced 83% below the control value, but the few eggs laid hatched normally. Females treated with a 0.75% concentration of *P,P*-bis(1-aziridinyl)-*N*-propylphosphinothioic amide for 3 days laid only 6 eggs, of which 4 hatched, compared to 75 eggs laid by the controls, of which 72 hatched under the same conditions; mortality was only 15% more than the control by 2 weeks posttreatment. Similarly, a 0.005% concentration of *P,P*-bis(1-aziridinyl)-*N*-ethylphosphinothioic amide reduced adult emergence and fecundity of males and females (mated to normal

weevils) to 12% or less. Another compound, bis(1-aziridinyl)ethylphosphine sulfide fed to males at 0.025% reduced adult emergence to 12%. When *N,N*-1,5-naphthylenebis(1-aziridine-carboxamide) was fed to males or females at 1%, adult emergence was reduced to 12% and fecundity was reduced by 96%.

TABLE 2.—*Highly effective, low-toxicity chemosterilants in normal-sterile boll weevil matings*¹

Compound	Concentration (%)	Effective against
Acetohydroxamic acid, <i>N</i> -fluoren-2-yl-	0.1-1	♂ ♀
Aziridine, 1,1'-methylenebis- ...	0.4-0.5	♀
1-Aziridinecarboxamide, <i>N,N'</i> -1,5-naphthylenebis-Do	1 0.5-1	♂ ♀
Guanidine, 1-nitro-3-[(2-pyridinylmethylene)amino]-	0.1-1.5	♂ ♀
1,9-Nonanediol, dimethanesulfonate . . .	0.1-0.4	♂ ♀
Phenol, <i>m</i> -(salicylideneamino)-	0.25-0.5	♀
Phosphine sulfide, bis(1-aziridinyl)ethyl-	0.025	♂
Phosphonic acid, bis(1-aziridinyl-, butyl ester Do	0.25-0.5 0.075	♂ ♀
Phosphinothioic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -ethyl- .	0.005-0.007	♂ ♀
Phosphinothioic amide, <i>P,P</i> -bis(1-aziridinyl)- <i>N</i> -propyl-	0.75	♀
Phosphonic diamide, <i>P</i> -(1-aziridinyl)- <i>N,N,N,N'</i> -tetramethyl-	0.2	♂

¹ Compounds reduced adult *F*₁ emergence to 15% or less and eggs laid to 25 or fewer during test period, with treated-parent mortality of no more than 33% by 7 days posttreatment.

Four nonaziridinyl compounds were also found to be effective when fed to boll weevils. For example, 1,9-nonanediol dimethanesulfonate fed to males (0.1%) or females (0.4%) resulted in virtually total sterility, but mortality was 3.5 to 4 times more than in the control in 14 days. Male or female weevils fed 0.1% to 1.5% 1-nitro-3-[(2-pyridylmethylene)amino]-guanidine and mated to normal weevils produced few or no offspring; mortality of treated females was at least twice that of males.

(Continued on page 30.)

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days

[1 replication of 50 weevils per test except as indicated]

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs ¹ collected (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
Acetamidoxime, N-(α,α,α -trifluoro- m-tolyl)-	62497	0.5	Acetone.	24	38	64	50	34
Acetimidic acid, N-benzylthio-, methyl ester	62095	.5	Methanol	12	14	100	80	22
Acetohydroxamic acid, N-methyl-	61934	2,3	Water.	72	---	52	38	27
Acetohydroxamic acid, N-fluorenyl-	50466	4.1	Methanol	---	36	4	50	0
Do.	50466	5.1	do	---	60	20	50	0
Do.	50466	4.2	do	---	78	0	---	---
Do.	50466	5.2	do	---	60	20	80	20
Do.	50466	.2	do	80	90	0	---	---
Do.	50466	4.4	do	---	36	8	75	0
Do.	50466	5.4	do	---	68	6	100	0
Do.	50466	.4	do	---	52	98	0	---
Do.	50466	4.1	do	---	84	8	75	0
Do.	50466	5.1	do	---	72	2	100	0
Do.	50466	1.5	do	---	38	2	100	0
Do.	50466	3.5	Water.	---	100	---	0	---
Acrylamide, N,N'-methylenebis-	8643							
Acrylamide, N,N'-propylidenebis-	61977	.5	Methanol	76	76	14	71	57
Acrylic acid, p-nitrophenyl ester.	61962	.5	do	76	76	54	70	22
Allophanic acid, 3-thio-4-(1H-1,2,4- triazol-3-yl)-, ethyl ester.	62550	2.1	do	18	34	100	48	26
Do.	62550	2.5	do	24	28	78	77	26
Ammonium, benzylmethyl[1-(methyl- thio)-ethylidene]----iodide.	62096	.5	Water.	4	6	100	66	30
Ammonium, [[bis(dimethylamino)- methylene]amino](methylthio)- methylene]dimethyl----iodide	62572	1	do	26	36	58	72	28
Ammonium, 2-butylenebis[tri- methyl----chloride].	61527	.5	do	6	12	100	46	20
Do.	61527	.75	do	30	58	16	38	13

Ammonium, [(dimethylamino)][(dithio- carboxyamino)methylene]di- methyl-----hydroxide, inner salt. .	62395	51	Acetone. . .	56	60	18	44	44
Do.	62395	41	. . do . . .	90	90	12	50	50
Ammonium, p,α-phenethylenebis[tri- methyl-----iodide].	61950	.5	Water. . . .	16	22	100	48	22
Aziridine, 1-(2,4-dinitro-1-naphthyl)-	62699	.25	Acetone. . .	2	8	100	80	60
Do.	62699	.5	. . do . . .	10	12	100	78	38
Do.	62699	1	. . do . . .	10	16	100	68	44
Do.	62699	4.3	. . do . . .	---	24	40	50	35
Aziridine, 1,1'-methylenebis-. . . .	50752	5.3	. . do . . .	---	4	28	36	43
Do.	50752	.3	. . do . . .	---	16	20	60	40
Do.	50752	5.4	. . do . . .	---	34	10	80	20
Do.	50752	4.4	. . do . . .	---	68	2	0	0
Do.	50752	.4	. . do . . .	---	12	6	0	0
Do.	50752	2,5.4	. . do . . .	12	20	45	53	21
Do.	50752	2,4.4	. . do . . .	20	36	34	37	41
Do.	50752	2,5.45	. . do . . .	88	96	100	6	4
Do.	50752	2,4.45	. . do . . .	60	88	3	100	100
Do.	50752	2,5.5	. . do . . .	40	60	19	33	42
Do.	50752	2,4.5	. . do . . .	16	44	12	50	50
Do.	50752	.5	. . do . . .	18	30	100	64	22
Do.	50752	1	. . do . . .	24	36	52	69	31
1-Aziridinecarboxamide, N,N'-1,5= naphthylenebis-.	50664	2,5.5	Methanol . .	20	24	94	61	25
Do.	50664	2,4.5	. . do . . .	20	24	14	90	35
Do.	50664	2,51	. . do . . .	24	28	100	42	12
Do.	50664	2,41	. . do . . .	24	32	3	0	50
1-Aziridinecarboxamide, N,N'-tetra- methylenebis-.	50838	5	Water. . . .	46	82	0	---	---
1-Aziridinecarboxamide, N,N'=	50987	2,5.3	. . do . . .	56	68	82	44	17
venylenebis-, (E)-.	50987	2,4.3	. . do . . .	48	64	11	83	17
Do.	50987	2,5.4	. . do . . .	84	88	100	40	18
Do.	50987	2,4.4	. . do . . .	84	88	12	59	59
1-Aziridineethanol, α-phenyl	50475	.03	. . do . . .	96	96	0	---	---
Do.	50475	5.05	. . do . . .	---	78	100	67	27
Do.	50475	4.05	. . do . . .	---	40	4	100	50
Do.	50475	5.075	. . do . . .	---	48	0	---	---
Do.	50475	4.075	. . do . . .	---	100	0	---	---
Do.	50475	2.1	. . do . . .	92	100	100	2	0

See footnotes at end of table.

Table 3--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1-Aziridineethanol, α -phenyl (continued)								
Do.	50475	50.1	Water.	---	100	0	---	---
Do.	50475	4,6.1	. . do	98	100	2	100	---
Do.	50475	2,5.15	. . do	88	92	100	0	0
Do.	50475	2,4.15	. . do	96	96	0	---	---
Do.	50475	5,6.2	. . do	44	72	30	69	20
Do.	50475	4,6.2	. . do	80	94	2	100	100
Do.	50475	5.4	. . do	---	100	34	71	24
Do.	50475	4.4	. . do	---	90	0	---	---
Do.	50475	.5	. . do	100	---	0	---	---
Do.	50475	51	. . do	---	100	0	---	---
Do.	50475	41	. . do	---	100	0	---	---
Do.	50475	51.5	. . do	---	92	22	45	18
Do.	50475	41.5	. . do	---	92	0	---	---
Benzenesulfonamide, p-methoxy-N=								
1-	62711	.5	Acetone.	16	26	100	70	34
Do.	62711	1	. . do	4	6	100	92	26
Benzaldehyde, 3,4-diethoxy-.	2069	.5	Water.	40	42	100	78	30
Benzamide, N-[bis(1-aziridinyl)phos- phenyl]-	62256	.05	Methanol	16	90	12	17	17
Do.	62256	.1	. . do	24	100	0	---	---
Do.	62256	.5	. . do	34	96	0	---	---
Benzamide, N-[bis(1-aziridinyl)phos- phenyl]-m-chloro-.	62345	.1	. . do	14	100	0	---	---
Do.	62345	2.25	. . do	77	96	0	---	---
Benzamide, N-[bis(1-aziridinyl)phos- phenyl]-o-chloro-.	62347	.05	. . do	46	98	0	---	---
Do.	62347	.1	. . do	76	100	0	---	---
Do.	62347	.5	. . do	84	98	0	---	---

Benzamide, <u>N</u> -[bis(1-aziridinyl)phosphinyl]- <u>p</u> -chloro-	62257	.05	Methanol . .	78	94	16	37	12
Do.	62257	.075	. . do . . .	40	100	0	---	---
Do.	62257	2.1	. . do . . .	53	98	0	---	---
Do.	62257	2.25	. . do . . .	60	99	0	---	---
Do.	62257	.5	. . do . . .	94	94	0	---	---
Benzamide, <u>N</u> -1-naphthyl-	62708	.5	Acetone. . .	4	4	100	80	38
Do.	62708	1	. . do . . .	0	6	100	88	40
Benzene, <u>m</u> -bis[(2-chlorovinyl)-sulfonyl]-	62373	1	. . do . . .	50	52	28	71	50
Do.	62373	1	Water. . .	76	78	6	100	67
Benzene, (2-nitropropenyl)-	15487	1	Methanol . .	8	12	98	63	37
Benzenesulfonamide, 3,4-dichloro= <u>N</u> -(2,4-dinitro-1-naphthyl)-	62756	1	Acetone. . .	6	6	100	76	28
Benzenesulfonamide, 3,4-dichloro= <u>N</u> -1-naphthyl-	62755	1	. . do . . .	2	4	100	76	30
Benzenesulfonamide, <u>N</u> -(2,4-dinitro-1-naphthyl)- <u>p</u> -methoxy-	62758	1	. . do . . .	92	92	0	---	---
Benzenesulfonamide, <u>N</u> , <u>N</u> '-tetramethylenebis[<u>N</u> -methyl]-	62570	.25	Methanol . .	12	16	100	66	24
Do.	62570	.5	. . do . . .	8	16	100	60	34
Do.	62570	1	. . do . . .	4	12	100	72	20
Benzenesulfonamide, 2,4,5-trichloro= <u>N</u> -(2,4-dinitro-1-naphthyl)-	62714	.5	Acetone. . .	80	82	28	43	29
Do.	62714	1	. . do . . .	60	72	36	61	33
Benzenesulfonamide, 2,4,5-trichloro= <u>N</u> -1-naphthyl-	62713	.5	. . do . . .	2	2	100	80	32
Do.	62713	1	. . do . . .	8	14	100	66	24
Benzenesulfonic acid, <u>p</u> -(4,5-dioxo-3-pentadecyl-2-pyrazolin-1-yl)-, 4-phenylhydrazone.	62314	2	. . do . . .	12	26	72	81	25
Benzofurazan, 1-oxide.	62099	.25	. . do . . .	14	26	80	73	25
Benzothiazole, 6-[2-diethylamino-ethoxy]-2-(dimethylamino)-, monohydrochloride.	62135	.5	Water. . . .	6	16	60	53	17
Do.	62135	.75	. . do . . .	88	90	0	---	---
4 <i>H</i> -3,1-Benzoxazin-4-one, 2-phenyl-Biurea, 1-(adamantyl)-	61952	.5	. . do . . .	26	48	100	43	24
Biurea, 1-anilino-6-(3,4-xylyl)-2, 5-dithio-	61883	.5	Methanol . .	36	36	84	71	38
Do.	62504	.5	Acetone. . .	36	60	46	43	30

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)	Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
Biuret, 5-(1-1-dimethyl-2,4-dithio-.)	62245	0.5	Acetone. . .	23	30	61	30
Biuret, 3-(p-chlorophenyl)-1,1-dimethyl-2,4-dithio-.	62230	.25	Methanol . .	40	62	47	32
Do.	62230	.5	. . do . . .	84	86	---	---
Do.	62230	2.5	Acetone. . .	82	88	25	16
Do.	62230	1	. . do . . .	96	96	33	33
Biuret, 1,1-dimethyl-2,4-dithio-	62244	.25	Methanol . .	100	---	---	---
Biuret, 5-ethyl-1,1-dimethyl-2,4=dithio-.	62248	.1	. . do . . .	74	80	40	30
Biuret, 1,1,5,5-tetramethyl-2,4=dithio-.	62250	.25	. . do . . .	72	80	33	33
Do.	62250	.5	. . do . . .	90	92	29	14
Do.	62250	1	Acetone. . .	64	66	61	44
Biuret, 1,1,5,5-tetramethyl-3=phenyl-2,4-dithio-.	62170	.5	. . do . . .	10	20	50	26
Biuret, 1,1,5-trimethyl-2,4-dithio-	62252	2.5	. . do . . .	99	99	---	---
Do.	62252	1	. . do . . .	96	96	---	---
2,3-Borane-dione.	25044	1	Methanol . .	4	6	93	50
Do.	25044	2	. . do . . .	16	34	34	0
Butane, 1,2,3,4-diepoxy	26592	.1	Acetone. . .	94	94	---	---
Butyric acid, 3-hydroxy-, hydrazide	62696	.05	Water. . . .	6	14	100	48
Do.	62696	.25	. . do . . .	12	12	100	42
Cadmium, bis(2,4-pentanedionate)-	61034	.25	Methanol . .	68	72	24	42
Do.	61034	.5	Acetone. . .	100	---	---	---
Carbamic acid, methylnitroso-, ester with 3-(p-hydroxyphenethyl)-1-methyl-1-nitrosourea	52773	.1	. . do . . .	20	36	73	0
Carbazic acid, 3-(morpholino-formimidoyl)dithio-.	62305	2	Water. . . .	30	46	71	43
Carbazic acid, 3-phenyldithio-, 2-methylallyl ester	62276	1	Methanol . .	12	16	68	34

Cinnamic acid, p-(dimethylamino)-	62575	1	Acetone. . .	8	14	90	78	37
Cinnamic acid, hydrazide	62695	.05	Water.	2	8	100	90	56
Do.	62695	.1	. . do	0	4	100	98	48
Do.	62695	.25	. . do	6	8	100	92	40
p-Cresol, α[[p-(methoxyphenoxy)-phenyl]imino]-2,6-dinitro.	62275	1	Acetone. . .	0	6	94	64	36
Do.	62275	2	. . do	18	32	66	79	15
2,5-Cyclohexadiene-1 ¹ , α-acetonitrile, 2,3-dichloro-4-oxo-α-phenyl-, oxime	62235	2	. . do	28	28	0	---	---
1,2-Cyclohexanepropionic acid, propyl ester	14235	.5	Methanol . .	84	86	0	---	---
3-Cyclohexene-1-carboxylic acid, 3-ethyl-2-methyl-4-phenyl-	62337	1	Acetone. . .	10	24	68	71	53
3-Cyclohexene-1-carboxylic acid, 5-ethyl-6-methyl-4-phenyl-	62334	1	. . do	16	32	100	52	52
3-Cyclohexene-1-carboxylic acid, 3-ethyl-2-methyl-4-phenyl, octyl ester.	62336	1	. . do	28	42	88	73	32
3-Cyclohexene-1-carboxylic acid, 5-ethyl-6-methyl-4-phenyl-, octyl ester.	62335	1	. . do	8	18	70	63	37
Cyclopropanecarboxamide, N,N'=methylenedi-	62076	.5	Methanol . .	24	34	100	80	24
Di-1-pyrrolidinecarboramide, dithio-	62246	.5	Acetone. . .	78	80	22	82	45
m-Dioxane, 5,5-dimethyl-2-(m-nitro-phenyl)-	32360	1	Water.	80	84	14	86	71
3H-1,2,4-Dithiazole, 5-(dimethyl-amino)-3-[[p(dimethylamino)phenyl]-imino]-, hydrogen sulfate (1:1)	62573	1	. . do	40	48	50	72	48
3H-1,2,4-Dithiazole, 5-(dimethyl-amino)-3-(2,5-dimethyl-3H-pyrrol-1-ylidene)-, hydrogen perchlorate	62538	.5	. . do	42	56	80	70	30
3H-1,2,4-Dithiazole, 5-(dimethyl-amino)-3-imino-, monohydrobromide	62512	.5	do	100	---	0	---	---
3H-1,2,4-Dithiazole, 5-(dimethyl-amino)-3-[(p-methoxyphenyl)imino]-, monohydrobromide	62559	.5	Methanol . .	56	58	58	69	24
3H-1,2,4-Dithiazole, 3-(phenylimino)=5-pyrrolidinyl-, hydrogen perchlorate.	62514	.5	Acetone. . .	100	---	0	---	---

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
3H-1,2,4-Dithiazole-3-thione, 5-morpholino-.	62454	0.5	Acetone. . .	10	18	100	48	30
3H-1,2,4-Dithiazole-3-thione, 5-phenyl-.	62269	2.5	. . do . . .	43	52	68	56	34
Do.	62269	1	. . do . . .	54	54	100	38	30
Do.	62269	2	. . do . . .	42	64	14	71	0
1,2,4-Dithiazolium, 3,5-bis(dimethyl- amino)----bromide.	61973	.1	Water. . . .	32	66	58	69	24
Do.	61973	.25	. . do . . .	94	94	0	---	---
Do.	61973	.5	. . do . . .	90	98	0	---	---
1,2,4-Dithiazolium, 3-[[bis(di- methylamino)methylene]amino]-5= dimethylamino)----bromide.	62535	.1	. . do . . .	36	82	50	52	16
Do.	62535	.5	. . do . . .	8	54	32	94	38
Do.	62535	2.5	. . do . . .	24	78	62	87	26
1,2,4-Dithiazolium, 3-[bis(2-hydroxy- ethyl)amino]-5-(dimethylamino)---- iodide	62208	.5	Methanol . .	58	74	60	43	20
1,2,4-Dithiazolium, 3-(dimethyl- amino)-5-(ethylthio)----perchlorate	62397	.1	Water. . . .	---	100	0	---	---
Do.	62397	.25	Acetone. . .	76	80	20	70	20
Do.	62397	6.5	. . do . . .	75	84	19	31	30
Do.	62397	21	. . do . . .	96	96	0	---	---
Do.	62397	1	Water. . . .	46	100	0	---	---
1,2,4-Dithiazolium, 3-(dimethyl- amino)-5-[hexahydro-1H-azepin-1-yl)- amino]----bromide.	62564	.5	. . do . . .	82	88	44	59	45
1,2,4-Dithiazolium, 3-(dimethylamino)= 5-(methylthio)----perchlorate. . .	62394	.25	Acetone. . .	92	92	2	100	100

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1,2,4-Dithiazol-1-ium, 3-(diethylamino)= 5-(dimethylamino)-----hydrogen sulfate	62077	0.25	Water. . . .	100	---	0	---	---
Do.	62077	2.5	Acetone. . . .	98	98	0	---	---
1,2,4-Dithiazol-1-ium, 3-(dimethyl- amino)-5-(methylamino)-----hydrogen sulfate.	62110	.5	. . do	62	62	90	73	31
1,2,4-Dithiazol-1-ium, 5-(dimethyl- amino)-3-morpholino-----hydrogen sulfate.	62078	.25	. . do	100	---	0	---	---
Do.	62078	2.5	. . do	100	---	0	---	---
1,2,4-Dithiazol-1-ium, 3-(dimethyl- amino)-5-(propylamino)-----hydrogen sulfate.	62111	.5	. . do	14	22	100	40	24
3H-1,2,4-Dithiazol-3-one, 5-(dimethyl- amino)-, dimethylhydrazone, mono- hydrobromide	62558	.5	Water. . . .	70	70	40	70	35
Do.	62558	1	. . do	78	90	0	---	---
[1,2,4]Dithiazolo[1,5-b][1,2,4]dithia- zole-4-S _{IV} , 2-anilino-6-(dimethyl- amino)-.	62566	.5	Acetone. . . .	6	22	82	63	32
Do.	62566	1	. . do	28	44	70	63	46
Do.	62566	2.5	. . do	32	36	100	66	46
[1,2,4]Dithiazolo[1,5-b][1,2,4]dithia- zole-4-S _{IV} , 2-(dimethylamino)-6- (methylamino)-.	62565	.5	. . do	2	6	70	71	20
1,3-Dithiole-4,5-dicarboxylic acid, 2-[(dimethylthiocarbamoyl)imino]-, dimethyl ester	62510	.5	Methanol . . .	44	62	42	43	33
1,3-Dithiole-4,5-dicarboxylic 2- [(piperidinothiocarbonyl)imino]-, dimethyl ester	62511	.5	Water. . . .	54	56	64	50	38

Ethane, 1,1,2,2-tetramorpholino-	62325	1	Methanol . . .	2	8	80	48
Ethylene, trimorpholino-	62324	41	Acetone . . .	36	58	16	38
Do.	62324	51	. . do . . .	4	12	100	40
Do.	62324	2	. . do . . .	50	68	8	0
Ethylenediamine, N,N,N',N'-tetraallyl- Formamide, N[4,6-bis(dimethylamino)= s-triazin-2yl]-N-methyl-	62126	.5	Water. . .	68	68	84	33
Furo[3,2-c]pyridin-4(5H)-one . . .	61203	.5	. . do . . .	36	42	100	20
D-Gluconic acid, hydrazide	62499	.5	Methanol . . .	84	92	0	0
Do.	19575	.25	Acetone. . .	4	14	100	72
Do.	19575	.5	. . do . . .	4	18	100	36
Do.	19575	1	. . do . . .	10	10	100	50
Glycine, N-glycyl-	62521	.5	Water. . .	14	18	100	30
Glycine, N,N-bis(2-hydroxyethyl)-	70344	.5	. . do . . .	6	14	100	14
Glycine, N,N'-ethylenedi-.	62471	.5	Acetone. . .	72	76	24	17
Glycine, N-[2-hydroxy-1,1-bis(hydroxy- methyl)ethyl]-	62523	.5	Water. . . .	8	10	100	36
Glyoxylic acid, cyano-, 2-oxime, methyl ester	62551	1	Methanol . . .	30	46	68	25
Do.	62551	.5	. . do . . .	10	34	100	36
Guanidine, 3-amino-1,1-dimethyl-, monohydride	62301	1	Water. . . .	4	10	94	47
Do.	62301	2	. . do . . .	14	24	46	13
Guanidine, 3-amino-1,1,2-trimethyl-, monohydride	62329	1	Methanol . . .	6	8	100	42
Guanidine, 1-nitro-3-[2-pyridyl- methylene)amino]-.	52077	.1	Water. . . .	30	36	70	31
Do.	52077	4.1	. . do . . .	---	76	4	0
Do.	52077	5.1	. . do . . .	---	32	14	0
Do.	52077	4.2	. . do . . .	---	100	0	---
Do.	52077	5.2	. . do . . .	---	24	0	---
Do.	52077	4.4	. . do . . .	---	36	6	100
Do.	52077	5.4	. . do . . .	---	36	0	---
Do.	52077	4.1	. . do . . .	---	80	0	---
Do.	52077	5.1	. . do . . .	---	48	0	---
Do.	52077	4.1.5	. . do . . .	---	60	0	---
Do.	52077	5.1.5	. . do . . .	---	24	0	---
Guanidine, 2,2'-oxalybis[1,1-di- methyl-	62562	.5	. . do . . .	14	20	100	0
Guanidine, 1-(4-oxo-2-thiazolin-2= yl)-	62563	.5	Acetone. . .	8	14	100	26
Heptanal	2066	.5	Water. . . .	16	26	94	21

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1-Hexadecanesulfonamide, N-(2,4 = dinitro-1-naphthyl)-.	62715	0.5	Acetone. . .	16	18	100	92	32
Do	62715	1	. . do . . .	2	4	100	62	28
1-Hexadecanesulfonamide, N-naphthyl- Do	62712	.5	. . do . . .	24	28	100	82	30
Do	62712	1	. . do . . .	0	0	100	72	24
1,1-Hydrazinedicarboxamide, hexa- methyldithio-	62567	.25	. . do . . .	30	38	76	74	45
Do	62567	.5	. . do . . .	78	82	30	60	33
Do	62567	1	. . do . . .	40	60	72	81	36
Hydroquinone, 2,5-di-tert-butyl-. . . 2-Imidazolidinone, 1-(2-chloroethyl)= 3-nitroso-.	16630	.5	Methanol . .	20	38	80	25	13
Do	52777	.1	Water. . .	68	68	77	66	0
Do	52777	5.2	. . do . . .	88	92	41	45	33
Do	52777	4.2	. . do . . .	96	96	0	---	---
Do	52777	5.3	. . do . . .	100	---	9	0	0
Do	52777	4.3	. . do . . .	100	---	0	---	---
2-Imidazolidinethione, 1,3-dimethyl- 2-Imidazolidione, 4 methyl-.	62400	1	Methanol . .	18	26	14	57	57
2-Imidazolinium, 1,3-dimethyl-2 = (dimethylamino)----iodide	62204	1	Water. . .	18	32	100	62	40
2-Imidazolinium, 1,3-dimethyl-2 = (methylthio)----iodide.	62402	1	. . do . . .	14	24	56	64	32
Do	62401	.5	. . do . . .	42	62	72	61	25
Do	62401	.5	Acetone. . .	94	94	0	---	---
Do	62401	1	Water. . .	58	62	4	100	100
2-Imidazolinium, 1,5-dimethyl-2 = (morpholino)----iodide.	62403	1	. . do . . .	4	12	42	62	48
Indole-2,3-dione, 1-methyl-, 3 = (thiosemicarbazone)	62297	2	Acetone. . .	30	94	28	71	36
Iron, bis(2,4-pentanedionate)-.	61033	.5	. . do . . .	70	82	42	52	33
Isocarbostyryl.	62131	.5	. . do . . .	40	44	100	40	22
Isocarbostyryl, 3-methyl-.	62503	.5	. . do . . .	38	46	20	70	40
Isocarbostyryl, 5,6,7-trimethoxy- Do	62391	1	. . do . . .	50	56	28	43	29

Ketone, 4,6-diamino-s-triazin-2-yl=phenyl-	62021	.5	Methanol . .	6	22	100	76	22
Lead, bis(2,4-pentanedionato)-	61035	.25	Water . . .	13	29	96	63	27
Melamine, N ₂ ,N ₂ -diethyl-N ⁴ ,N ⁴ ,N ⁶ ,N ⁶ =tetramethyl-, monohydrochloride	60227	.5	. . do . . .	58	70	80	60	33
Melamine, N ₂ ,N ₂ -diisopropyl-N ⁴ ,N ⁴ ,N ⁶ ,N ⁶ -tetramethyl-	61751	.5	Acetone. . .	54	68	94	72	28
Melamine, N ₆ -ethyl-N ₂ ,N ₂ ,N ⁴ ,N ⁴ -tetramethyl-	60299	.5	Methanol . .	34	50	58	66	24
Melamine, N ₆ -ethyl-N ₂ ,N ₂ ,N ⁴ ,N ⁴ -tetramethyl-, hydrochloride	60300	.5	. . do . . .	20	48	58	72	24
Melamine, hexamethyl-	50852	.5	Acetone. . .	50	58	68	50	26
Melamine, hexamethyl-, hydrochloride	50905	.5	Water. . . .	66	80	66	61	27
Melamine, N ₆ -isopropyl-N ₂ ,N ₂ ,N ⁴ ,N ⁴ =tetramethyl-, hydrochloride	60338	.5	. . do . . .	36	54	58	59	24
Melamine, N ₂ -methoxy-N ₂ ,N ⁴ ,N ⁴ ,N ⁶ ,N ⁶ =pentamethyl-, monohydrochloride	61486	.5	Methanol . .	58	70	72	53	31
Melamine, N ₆ -tert-butyl-N ₂ ,N ₂ ,N ⁴ ,N ⁴ =tetramethyl-	61750	.5	Acetone. . .	52	66	44	82	50
Melamine, N ₂ ,N ₂ ,N ⁴ ,N ⁴ -tetramethyl-, hydrochloride	51146	.5	. . do . . .	28	44	30	73	47
Melamine, N ₂ ,N ⁴ ,N ⁶ -trichloro-	60131	.5	Methanol . .	8	16	100	60	22
N ¹ -Melaminium, N ¹ ,N ₂ ,N ⁴ ,N ⁴ ,N ⁶ ,N ⁶ =heptamethyl---chloride	62548	.5	Water. . . .	46	60	26	77	15
Methanesulfonic acid, nonamethylene ester(1,9-nonanediol, dimethanesulfonate)	26397	5.1	. . do . . .	32	84	50	32	8
Do.	26397	4.1	. . do . . .	36	100	0	---	---
Do.	26397	5.2	. . do . . .	40	92	24	58	25
Do.	26397	4.2	. . do . . .	32	88	24	75	50
Do.	26397	5.4	. . do . . .	38	88	20	50	0
Do.	26397	4.4	. . do . . .	32	100	0	---	---
Do.	26397	5.1	. . do . . .	48	96	16	13	0
Do.	26397	4.1	. . do . . .	38	72	0	---	---
Do.	26397	1	. . do . . .	46	100	0	---	---
Do.	26397	5.1.5	. . do . . .	28	44	0	---	---
Do.	26397	4.1.5	. . do . . .	46	100	0	---	---
Do.	2845	.5	. . do . . .	4	8	80	43	23
4-Morpholinecarboxaldehyde	62302	1	. . do . . .	2	4	62	61	35
4-Morpholinecarboximidic acid, hydrazide, monohydride	62517	.5	. . do . . .	14	26	100	68	32
4-Morpholineethanesulfonic acid								

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1-Naphthalenecarbamic acid, 4-nitro-, phenyl ester	62705	0.5	Acetone. . .	0	0	100	90	28
Do.	62705	1	. . do . . .	18	22	100	84	28
1-Naphthalenecarbamic acid, phenyl ester.	62704	.5	. . do . . .	4	4	100	90	28
Do.	62704	1	. . do . . .	10	16	100	80	30
2-Naphthalenesulfonamide, N-methyl- 1H-Naphtho[1,8-de]-v-triazine. . .	2054	.5	Water. . .	18	38	82	71	27
1-Naphthylamine, N,N-dimethyl-2, 4-dinitro-	62216	.5	Acetone. . .	72	80	0	---	---
Do.	62698	.05	Water. . .	2	6	100	80	54
Do.	62698	.1	. . do . . .	2	10	100	90	36
Do.	62698	.25	. . do . . .	0	8	100	76	38
Naphth[1,2-d][1,3,2]oxazaborole, 1,2= dihydro-2-phenyl	61380	5.75	. . do . . .	80	88	100	4	4
Do.	61380	4.75	. . do . . .	68	88	0	---	---
Nicotinonitrile, 1-(furfurylidene- amino)-1,2-dihydro-4,6-dimethyl- 2-oxo-	81716	1	Acetone. . .	10	12	86	65	65
1-Nonen-4-ol	82578	1	Water. . .	8	8	94	36	36
2-Octene, 6,7-epoxy-3,7-dimethyl-1= (2-propynoxy)-	70351	.5	Acetone. . .	12	16	100	67	42
2-Oxazolin-5-one, 2-phenyl-4= veratrylidene-	62486	.5	. . do . . .	6	8	88	77	25
Phenethyl alcohol, α-allyl-	62409	1	Water. . .	6	14	62	39	39
Phenol, 2,4-dinitro-, formate. . .	61963	.25	Methanol . .	82	84	0	---	---
Phenol, m-(salicylideneamino)- . .	52102	5.25	. . do . . .	0	0	86	72	30
Do.	52102	4.25	. . do . . .	4	16	15	88	36
Do.	52102	5.5	. . do . . .	0	8	42	58	33
Do.	52102	4.5	. . do . . .	4	12	36	56	56
Phenol, (2,4,6-)tris(ethylamino- methyl)-	3348	.5	Water. . .	14	14	100	62	14

Phenoxazine, 1,3-dinitro-	62496	.5	Acetone.	8	32	100	76	36
m-Phenylenediamine, 4,6-dinitro- Do.	62552 62552	1 .5	. . do do	18 10	36 14	100 100	72 78	30 26
Phosphine oxide, bis(1-aziridinyl)- ethyl-,	61586 61586 61586 61586 61586 61586 61586	.05 .1 .1 2,5,2 2,4,2 .25 .5	Water. do Methanol do do do Water,	8 16 4 16 8 36 34	20 34 18 26 12 74 44	100 12 62 100 76 2 16	44 33 52 39 53 0 25	12 33 26 25 13 0 12
Phosphine sulfide, bis(1-aziridinyl)- ethyl-,	61587 61587 61587 61587 61587 24916 24916 24916	5, .025 4, .025 5, .05 4, .05 .25 .05 .25 2, 1	Methanol do do do do Water. do do	16 12 24 12 80 100 100 68	32 24 44 28 94 --- --- 97	84 90 100 84 0 0 0	74 60 76 79 --- --- ---	12 40 26 16 --- --- ---
Phosphine sulfide, tris(1-aziridinyl) Do.	61354 61354 61354 61354 61354 61354 61354 61354	.03 .05 5, .075 4, .075 5, .075 5, 1 4, 1 2, 1 .25 .5	. . do do do do do do do do	8 66 12 20 98 10 8 49 100 98	98 100 86 88 98 94 92 97 --- 98	0 0 100 14 0 100 40 0 0	--- --- 24 89 --- 0 60 --- ---	--- --- 10 73 --- 0 30 --- ---
Phosphinic acid, bis(1-aziridinyl)-, butyl ester.	50761 50761 50761 50761 50761 50761 50761 50761	2,5, .025 2,4, .025 5,6, .05 4,6, .05 2,5, .075 2,4, .075 2,5, 1 2,5, 1	Methanol do Water. Methanol do do Water. Methanol	92 100 8 72 74 88 72 84	96 --- 80 82 80 92 76 96 88	99 0 10 100 23 100 5 4 4	84 --- 40 49 64 12 100 0 0	24 --- 20 18 59 0 50 0 0

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
Phosphinic acid, bis(1-aziridinyl)-, ethyl ester (continued).	50761	2,4,1	Methanol . .	100	---	0	---	---
Do.	50761	2,5,2	. . do . . .	88	92	50	28	0
Do.	50761	2,4,2	. . do . . .	100	---	0	---	---
Do.	50761	.5	Water. . . .	38	98	0	---	---
Do.	50761	.51	Acetone. . .	---	12	56	54	57
Do.	50761	.41	. . do . . .	---	8	70	66	34
Phosphinic acid, bis(1-aziridinyl)-, isopropyl ester.	61355	.05	Water. . . .	88	100	0	---	---
Do.	61355	.1	. . do . . .	98	98	0	---	---
Do.	61355	.5	. . do . . .	98	98	0	---	---
Phosphinic acid, bis(1-aziridinyl)-, methyl ester	61342	2.03	. . do . . .	10	52	12	17	0
Do.	61342	.05	. . do . . .	100	---	0	---	---
Do.	61342	.1	. . do . . .	14	98	0	---	---
Do.	61342	.2	. . do . . .	8	76	100	0	0
Do.	61342	.2	. . do . . .	8	56	0	---	---
Do.	61342	.5	. . do . . .	46	86	0	---	---
Phosphinic acid, bis(1-aziridinyl)-, propyl ester	61343	.05	. . do . . .	20	40	54	70	0
Do.	61343	.075	. . do . . .	98	98	0	---	---
Do.	61343	2.1	. . do . . .	23	70	5	30	0
Do.	61343	.25	. . do . . .	98	98	0	---	---
Do.	61343	.5	. . do . . .	98	98	0	---	---
Phosphinic amide, P,P-bis(1-aziri- diny1)-N-(m-chlorophenyl). . . .	62343	.05	Methanol . .	50	54	100	72	34
Do.	62343	2.1	. . do . . .	50	70	26	50	23
Do.	62343	.25	. . do . . .	94	94	0	---	---
Do.	62343	.5	. . do . . .	88	98	0	---	---
Phosphinic amide, P,P-bis(1-aziri- diny1)-N-(p-chlorophenyl). . . .	62342	.04	Acetone. . .	24	32	12	83	17
Do.	62342	.05	. . do . . .	10	62	54	100	0

Do.	62342	.1	. . do . . .	30	92	0	---	---
Do.	62342	.2	. . do . . .	16	76	100	50	18
Do.	62342	.3	. . do . . .	64	86	22	27	0
Do.	62342	.5	Water. . . .	6	18	100	58	20
Do.	62342	.5	Acetone. . .	48	100	0	---	---
Phosphinic amide, P,P-bis(1-aziridinyl)-N-(o-chlorophenyl)-	62346	.05	Methanol . .	4	20	100	60	12
Do.	62346	.1	. . do . . .	10	16	70	14	5
Do.	62346	5.2	. . do . . .	16	20	100	90	36
Do.	62346	.25	. . do . . .	32	40	98	67	16
Do.	62346	.3	. . do . . .	6	8	100	42	10
Do.	62346	.5	. . do . . .	26	74	2	0	0
Phosphinic amide, P,P-bis(1-aziridinyl)-N-isopropyl-.	51256	.05	Water. . . .	98	98	0	---	---
Do.	51256	.075	. . do . . .	68	98	0	---	---
Do.	51256	2.1	. . do . . .	58	99	0	---	---
Do.	51256	.25	. . do . . .	96	97	0	---	---
Do.	51256	.5	. . do . . .	98	98	0	---	---
Phosphinic amide, P,P-bis(1-aziridinyl)-N-methyl-.	51254	.05	. . do . . .	20	100	0	---	---
Do.	51254	.1	. . do . . .	18	96	0	---	---
Do.	51254	.5	. . do . . .	82	100	0	---	---
Phosphinic amide, P,P-bis(1-aziridinyl)-N-phenyl-.	62258	.05	. . do . . .	20	68	34	0	0
Do.	62258	.1	. . do . . .	24	92	20	0	0
Do.	62258	.5	. . do . . .	20	94	0	---	---
Phosphinic amide, P,P-bis(1-aziridinyl)-N-propyl-.	51253	1	. . do . . .	76	84	---	---	---
Do.	51253	1	. . do . . .	24	32	20	0	0
Phosphinothioic acid, bis(1-aziridinyl)-, O-ethyl ester	50042	.1	Methanol . .	10	90	0	---	---
Do.	50042	.25	. . do . . .	78	98	0	---	---
Do.	50042	.3	. . do . . .	80	98	0	---	---
Phosphinothioic acid, bis(1-aziridinyl)-, S-ethyl ester	61582	.02	. . do . . .	36	94	0	---	---
Do.	61582	5.05	. . do . . .	24	88	100	4	2
Do.	61582	4.05	. . do . . .	24	69	0	---	---
Do.	61582	.05	. . do . . .	14	98	0	---	---
Do.	61582	5.1	. . do . . .	40	88	34	6	0
Do.	61582	4.1	. . do . . .	60	92	0	---	---
Do.	61582	5.2	. . do . . .	56	76	8	50	25

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3--	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				at---	Day			
				Day	14			
				7				
Phosphinothioic acid, bis(1-aziri- diny1)-, S-ethyl ester (continued)	61582	.02	Methanol . .	88	100	0	---	---
Do.	61582	.4	. . do . . .	100	---	0	---	---
Phosphinothioic acid, bis(1-aziri- diny1)-, O-methyl ester. . . .	50765	.05	. . do . . .	98	98	0	---	---
Do.	50765	2.1	. . do . . .	50	94	0	---	---
Do.	50765	2.25	. . do . . .	92	100	0	---	---
Do.	50765	.5	. . do . . .	100	---	0	---	---
Do.	50765	1	. . do . . .	98	98	0	---	---
Phosphinothioic acid, bis(1-aziri- diny1)-, S-methyl ester. . . .	61583	.05	. . do . . .	6	8	100	42	22
Do.	61583	2.1	. . do . . .	100	---	0	---	---
Do.	61583	.25	. . do . . .	100	---	0	---	---
Do.	61583	.3	. . do . . .	8	98	0	---	---
Do.	61583	.5	. . do . . .	98	98	0	---	---
Phosphinothioic amide, P,P-bis(1- aziridinyl)-	61969	.05	. . do . . .	72	98	0	---	---
Do.	61969	2.1	. . do . . .	52	100	2	0	0
Do.	61969	.2	. . do . . .	96	96	0	---	---
Do.	61969	.25	. . do . . .	88	100	0	---	---
Do.	61969	.5	. . do . . .	100	---	0	---	---
Phosphinothioic amide; P,P-bis(1- aziridinyl)-N-butyl-	62489	.1	Acetone. . .	38	78	0	---	---
Do.	62489	.25	. . do . . .	98	98	0	---	---
Do.	62489	.5	. . do . . .	100	---	0	---	---
Phosphinothioic amide, P,P-bis(1- aziridinyl)-N,N-dimethyl-	62492	.1	Water. . . .	44	94	0	---	---
Do.	62492	.25	. . do . . .	98	98	0	---	---
Do.	62492	.5	. . do . . .	100	---	0	---	---
Phosphinothioic amide, P,P-bis(1- aziridinyl)-N-ethyl-	61581	.005	Acetone. . .	4	12	96	34	12
Do.	61581	.005	. . do . . .	36	48	7	0	0

Do.	61581	5.006	. . do . . .	12	20	12	83	33
Do.	61581	4.006	. . do . . .	14	40	2	0	0
Do.	61581	.006	. . do . . .	16	40	0	---	---
Do.	61581	5.007	. . do . . .	8	44	8	50	50
Do.	61581	4.007	. . do . . .	20	68	4	0	0
Do.	61581	.007	. . do . . .	18	52	0	---	---
Do.	61581	5.0075	. . do . . .	48	56	100	0	0
Do.	61581	4.0075	. . do . . .	72	76	1	100	100
Do.	61581	5.01	. . do . . .	92	92	94	0	0
Do.	61581	4.01	. . do . . .	80	80	0	---	---
Do.	61581	5.05	Methanol . . .	88	92	100	0	0
Do.	61581	4.05	. . do . . .	96	96	2	0	0
Do.	61581	.05	. . do . . .	100	---	0	---	---
Do.	61581	5.075	. . do . . .	84	88	100	0	0
Do.	61581	4.075	. . do . . .	100	---	2	0	0
Do.	61581	.075	. . do . . .	76	100	0	---	---
Do.	61581	.1	. . do . . .	55	98	0	---	---
Do.	61581	2.25	. . do . . .	94	99	0	---	---
Do.	61581	.5	. . do . . .	96	96	0	---	---
Phosphinothioic amide, P,P-bis(1=aziridinyl)-N-hexyl-	62491	.5	Water. . . .	34	50	0	---	---
Phosphinothioic amide, P,P-bis(1=aziridinyl)-N-methyl-	61585	5.04	Methanol . . .	50	84	100	43	5
Do.	61585	4.04	. . do . . .	52	100	0	---	---
Do.	61585	.05	. . do . . .	6	92	0	---	---
Do.	61585	5.06	. . do . . .	100	---	35	20	20
Do.	61585	4.06	. . do . . .	100	---	0	---	---
Do.	61585	.1	. . do . . .	98	98	0	---	---
Do.	61585	5.25	. . do . . .	100	---	0	---	---
Do.	61585	4.25	. . do . . .	98	98	0	---	---
Do.	61585	.5	. . do . . .	100	---	0	---	---
Phosphinothioic amide, P,P-bis(1=aziridinyl)-N-phenyl-	62344	.05	Acetone. . . .	94	94	0	---	---
Do.	62344	2.1	. . do . . .	58	97	0	---	---
Do.	62344	.25	. . do . . .	98	98	0	---	---
Do.	62344	.5	. . do . . .	94	94	0	---	---
Phosphinothioic amide, P,P-bis(1=aziridinyl)-N-propyl-	61580	5.75	Water. . . .	64	84	100	2	0
Do.	61580	4.75	. . do . . .	32	40	6	67	67
Do.	61580	5 ₁	. . do . . .	54	78	53	9	9
Do.	61580	4 ₁	. . do . . .	72	88	46	65	43

See footnotes at end of table.

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
Phosphonic diamide, P-bis(1-aziridinyl)-N,N,N',N'-tetramethyl-	50991	2,50.1	Water.	0	8	80	40	20
Do.	50991	2,4.1	do	4	20	66	47	46
Do.	50991	5,6.2	do	24	42	83	4	2
Do.	50991	4,6.2	do	44	54	16	65	57
Do.	50991	2,5.25	do	40	48	100	0	0
Do.	50991	2,4.25	do	56	84	9	75	59
Do.	50991	2,5.3	do	76	84	24	0	0
Do.	50991	2,4.3	do	72	76	0	---	---
Do.	50991	2,5.4	do	80	88	25	10	6
Do.	50991	2,4.4	do	100	---	0	---	---
Do.	50991	.5	Acetone.	60	74	14	14	0
Do.	50991	1	Methanol	100	---	0	---	---
Do.	50991	52	Acetone.	---	28	18	33	33
Do.	50991	42	do	---	100	0	---	---
Phosphonic diamide, N,N,N',N'-tetramethyl-P-(4-methyl-1-piperazinyl)-	61117	5.025	do	12	20	43	40	24
Do.	61117	4.025	do	100	---	0	---	---
Do.	61117	2,5.05	do	14	24	60	50	24
Do.	61117	2,4.05	do	14	34	76	70	26
Do.	61117	2,5.1	do	0	4	89	66	25
Do.	61117	2,4.1	do	8	26	99	76	25
Do.	61117	2,5.2	do	4	16	64	44	25
Do.	61117	2,4.2	do	0	14	69	57	37
Do.	61117	.2	do	16	48	22	27	55
Do.	61117	5.3	do	46	100	0	---	---
Do.	61117	4.3	do	52	100	0	---	---
Phosphonic diamide, N,N,N',N'-tetramethyl-P-propyl-	62469	.5	Water.	8	12	100	50	16
Do.	62469	.75	do	50	64	10	60	60
Phosphoric triamide, N,N-dimethyl-	52918	1	do	24	24	100	76	28

Phosphoric triamide, hexamethyl-	50882	.02	Acetone. . .	42	50	70	23	17
Do.	50882	.1	Water. . .	72	84	0	---	---
Do.	50882	.5	Acetone. . .	30	46	4	50	0
Do.	50882	.5	Water. . .	4	4	80	23	13
Do.	50882	1	Acetone. . .	100	---	0	---	---
Phosphorothioic triamide, hexamethyl-	50918	1	. . do . . .	72	82	0	---	---
Do.	50918	1	. . do . . .	98	98	0	---	---
Phthalic acid, 3-nitro-	2074	.5	Water. . .	32	34	100	42	16
1-Piperazineethanesulfonic acid, 4-(2-hydroxyethyl)-	70343	.5	. . do . . .	94	94	0	---	---
Piperidinecarbodithioic acid, 4,4'- trimethylenebis-, diammonium salt	62215	2.5	. . do . . .	5	13	100	60	26
1-Piperidinecarboxy-2,4-xylylidide, '4,4''-trimethylenebis[thio]-	62553	.5	Acetone. . .	20	38	96	94	31
Do.	62553	1	. . do . . .	28	36	70	80	29
1-Piperidinecarboxy-3,4-xylylidide, 4,4''-trimethylenebis[thio]-	62554	.5	. . do . . .	8	18	100	96	38
Do.	62554	1	. . do . . .	26	40	78	62	23
Piperidine, 1-methyl-, 1-oxide, picrate.	60171	5.2	Methanol . .	0	4	96	82	22
Do.	60171	4.2	. . do . . .	8	12	66	83	28
Do.	60171	5.25	. . do . . .	8	8	100	84	38
Do.	60171	4.25	. . do . . .	8	20	96	63	21
Do.	60171	5.3	. . do . . .	4	8	98	75	31
Do.	60171	4.3	. . do . . .	8	12	92	77	29
Piperidine, 4,4'-trimethylenebis[l=	62387	5.1	. . do . . .	8	10	100	62	24
(1-cyclohexen-1-yl)-	62387	4.1	. . do . . .	54	66	6	100	100
Do.	61833	2,5.8	. . do . . .	64	80	100	70	20
Piperidine, 4,4'-trimethylenedi-	61833	2,4.8	. . do . . .	72	76	5	25	25
Do.	62375	1	Acetone. . .	24	30	44	77	73
4-Piperidinol, 4-(p-fluorophenyl)-	52764	5.25	. . do . . .	76	84	54	60	49
Plumbane, chlorotriphenyl-	52764	4.25	. . do . . .	100	---	0	---	---
Do.	52764	5.5	. . do . . .	100	---	0	---	---
Do.	52764	4.5	. . do . . .	100	---	0	---	---
Do.	52764	2	Water. . .	48	62	10	80	40
Potassium tetrachloroplatinate (II)	62315	.5	. . do . . .	100	0	---	---	---
Propane, 1,2-dibromo-3-chloro-	18445	2.5	. . do . . .	88	90	6	100	0
1,3-Propanediol, 2-bromo-2-nitro-	61639	2.1	Acetone. . .	20	36	115	51	3
1,3-Propanediol, dimethanesulfonate	51904	2,52	. . do . . .	96	96	39	27	28

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1,3-Propanediol, dimethanesulfonate (continued)	51904	2,5	Acetone.	100	---	35	24	20
Do.	51904	2,4	. . do . . .	100	---	0	---	---
1-Propanol, 2,3-dibromo-	26304	.5	Water.	64	74	38	100	0
Propionamide, 3-chloro-N-(benzyloxy)-	62307	1	Methanol . .	26	32	100	56	28
Do.	62307	2	. . do . . .	24	50	6	33	33
Propionanilide, 3-chloro-4'-fluoro-	62308	2	. . do . . .	4	14	60	77	27
Pseudourea, 2-methyl-2-thio-1-(thio- carbamoyl)-	62327	1	Acetone.	60	64	51	79	69
Pyridazine, 3-chloro-6-nitramino-	62136	.5	Methanol . .	16	32	100	54	32
Pyridine, 1,2-dihydro-2-[(2,4,6= trinitrophenyl)imino]-	62362	1	Acetone.	12	18	70	86	51
Pyridine, 4-phenyl-, 1-oxide . .	62312	.05	Water.	74	88	44	23	23
Do.	62312	1	. . do . . .	100	---	0	---	---
3-Pyridinepropionic acid, α -(hydroxy- imino)- β -oxo-, ethyl ester . . .	62495	.5	Methanol . .	44	58	62	84	35
Pyridinium, 1,1'-tetramethylene- di-----dichloride	61628	.5	Water.	6	14	100	38	18
Do.	61628	.75	. . do . . .	12	22	100	70	40
2(LH)-Pyridone, 1-ethyl-4-hydroxy-6= methyl-.	62316	1	Methanol . .	36	60	20	50	50
Do.	62316	2	. . do . . .	20	42	54	81	33
2(LH)-Pyridone, 3-hydroxy-, acetate	62481	.5	. . do . . .	6	16	100	80	16
Do.	62481	.75	. . do . . .	30	42	30	73	40
Pyrrole-1-acetamide, 2,4-dinitro-N= propyl-.	62149	1	Acetone.	26	46	48	79	17
Semicarbazide, 1-benzoyl-3-thio-	51986	5,6	Water.	6	6	67	71	22
Do.	51986	4,6	. . do . . .	6	18	57	75	34
Semicarbazide, 1-[4,6-bis(dimethyl- amino)-s-triazin-2-yl]-4-phenyl-	62408	1	. . do . . .	12	28	24	25	25
Serine, 3-[3,4-(methylenedioxy)- phenyl], L-.	62576	1	Acetone.	12	30	100	46	44

Sodium, (2-pyridylthio)-, N-oxide	22596	.25	Water. . . .	0	96	92	52
Do.	22596	.5	. . do . . .	8	100	90	46
Do.	22596	1	. . do . . .	100	0	---	---
Do.	22596	2	. . do . . .	100	0	---	---
Sodium tetrabutoxyborate	60372	5.75	Methanol . .	20	52	66	20
Do.	60372	4.75	. . do . . .	72	4	75	0
Spiro[benz[cd]indole-5(1H), 3'=indoline]-3,4-dicarboxylic anhydride, 1,1'-diacetyl-2,4-dihydro-2,2'-dioxo, compound with pyridine (1:1)	62355	1	Acetone. . .	12	38	74	74
Styrene, β -nitro	16827	.5	. . do . . .	30	100	60	34
Sulfone, 2-chloro-2-butenyl, 2,5-dichlorophenyl, (E)-	62371	1	. . do . . .	28	20	50	50
Sulfone, 2-chlorovinyl, 2,5-dichlorophenyl	62372	1	. . do . . .	80	12	50	50
Sulfanilic acid, N-acetylthio-, S=(trichloromethyl) ester.	62354	5 ₁	Methanol . .	22	46	61	48
Do.	62354	4 ₁	. . do . . .	10	64	41	41
Tartaramide, N,N'-diallyl-	62352	1	Acetone. . .	8	100	70	46
Tartar emetic.	19187	.5	. . do . . .	90	24	58	16
Taurine, N,N-bis(2-hydroxyethyl)-, Taurine, N-[2-hydroxy-1,1-bis(hydroxymethyl)ethyl]-	62516	.5	Water. . . .	12	100	80	32
Tepa	62522	.5	. . do . . .	12	100	60	38
Do.	24915	.05	. . do . . .	88	4	100	0
Do.	24915	.25	. . do . . .	92	0	---	---
Do.	24915	.1	. . do . . .	76	0	---	---
Do.	24915	.5	. . do . . .	98	0	---	---
Do.	24915	1	Methanol . .	100	0	---	---
1H-Tetrazole, 5-bromo-1-phenyl-. .	62483	.5	Acetone. . .	16	100	80	28
1H-Tetrazole, 5-chloro-1-phenyl- .	61645	2.5	. . do . . .	20	86	42	30
2H-Tetrazolium, 2,3,5-triphenyl----bromide.	62388	5 ₁	Water. . . .	12	90	53	27
Do.	62388	4 ₁	. . do . . .	68	8	100	100
1,3,5-Thiadiazine-2-one, 4,6=dipiperidino-.	62321	1	Methanol . .	38	26	46	46
Do.	62321	2	. . do . . .	88	0	---	---
1,3,5-Thiadiazinium, 2,6-bis(dimethylamino)-4-morpholino----iodide	62406	1	. . do . . .	68	38	63	53
1,3,5-Thiadiazinium, 2,6-bis(dimethylamino)-4-piperidino----iodide. .	62404	1	Water. . . .	96	36	83	39

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%)		Total eggs collected ¹ (days 7 & 14)	Avg. egg hatch, days 7 & 14 (%)	Avg. adult emergence, days 7 & 14 (%)
				Day 7	Day 14			
1,3,5-Thiadiazinium, 2,6-bis(dimethyl- amino)-4-(1-pyrrolidinyl)----- iodide	62405	1	Water. . . .	84	84	14	71	71
1,2,5-Thiadiazole, 3-chloro-4 = morpholino-	62392	1	Acetone. . . .	64	76	52	50	50
1,2,4-Thiadiazole], 5,5'-dithio- bis[3-bromo-	62332	1	Methanol . . .	2	20	68	79	53
Δ ² -1,3,4-Thiadiazoline-5-thione, 2-methyl-	62194	21	Acetone. . . .	16	16	85	66	31
1,2,3,4-Thiaziazole, 5-(dimethyl- amino)-	62556	.5	Methanol . . .	100	---	0	---	---
Do.	62556	1	. . do	96	96	0	---	---
Thiazole, 2-amino-5-bromo-, mono- hydrobromide	61777	.1	Water. . . .	100	---	0	---	---
Do.	61777	.25	. . do	98	98	0	---	---
Do.	61777	.5	. . do	98	98	0	---	---
Thiazole, 2-amino-4-(p-nitrophenyl)- 4-Thiazoline-4,5-diacarboxylic acid, 3-(1-adamantyl)-2-[(dimethylthio- carbamoyl)imino]-, dimethyl ester	62320	2	Acetone. . . .	12	16	82	78	15
4-Thiazoline-4,5-dicarboxylic acid, 3-(p-chlorophenyl)-2-[(dimethyl- thiocarbamoyl)imino]-, dimethyl ester.	62505	.5	. . do	30	48	64	59	34
4-Thiazoline-4,5-dicarboxylic acid, 2-[(dimethylthiocarbamoyl)imino] = 3-phenyl-, dimethyl ester.	62502	.5	. . do	18	38	48	75	42
Thieno[3,2-c]pyridin-4(5H)-one . . .	62501	.5	. . do	26	38	100	46	18
Thione, 2-furyl morpholino-	62498	.5	. . do	62	70	10	80	60
2-Thiophenesulfonamide, N-(2,4-di- nitro-1-naphthyl)-	61554	.5	. . do	48	52	88	41	25
Do.	62710	.5	. . do	14	16	80	55	33
Do.	62710	1	. . do	24	24	100	70	30

2-Thiophenesulfonamide, N-1-naphthyl-	62706	.5	. . do . . .	6	10	100	68	20
Do	62706	1	. . do . . .	20	26	100	72	22
p-Toluenesulfonamide, N-(-1-nitro-2-naphthyl)-	62707	.5	. . do . . .	46	48	100	72	22
Do	62707	1	. . do . . .	46	48	100	66	38
s-Triazine, 2-acetamido-4,6-bis-(dimethylamino)-	60235	.5	. . do . . .	36	48	100	64	28
s-Triazine, 2-amino-4-(methylamino)=6-(1-pyrrolidinyl)-	60250	.5	. . do . . .	8	10	100	64	28
s-Triazine, 2-amino-4-(phenethyl-amino)-, hydrochloride	60029	.5	Water . . .	10	32	100	72	22
s-Triazine, 2,4-bis(dimethylamino)-5-ethoxy-	61512	.5	Methanol . .	14	24	100	68	24
s-Triazine, 2,4-bis(dimethylamino)-6-isopropyl-	61490	.5	. . do . . .	10	32	100	72	22
s-Triazine, 2,4-bis(dimethylamino)-6-(1-pyrrolidinyl)-	60121	.5	Acetone . .	50	54	100	70	16
s-Triazine, 2,4-bis(isopropylamino)=6-(methylthio)-	60366	.5	. . do . . .	32	40	100	44	24
s-Triazine, 2,4-bis(methylamino)-6-morpholino-	60123	.5	Methanol . .	30	40	100	82	30
s-Triazine, 2-chloro-4-(diethyl-amino)-6-(ethylamino)-	60363	.5	Acetone . .	6	18	100	82	28
s-Triazine, 4,6-diamino-1-(p-chloro-phenyl)-1,2-dihydro-2,2-dimethyl-, monohydrochloride.	26080	.5	Methanol . .	4	24	100	66	18
s-Triazine, 2,4-diamino-6-sec-butyl-	60104	.25	. . do . . .	18	34	100	68	22
s-Triazine, 4,6-diamino-1,2-dihydro-2,2-dimethyl-1-(2-naphthyl)-, monohydrochloride.	60128	.5	Acetone . .	12	16	100	86	28
Do	60128	5.75	. . do . . .	8	16	50	56	24
Do	60128	4.75	. . do . . .	8	12	81	66	30
Do	60128	51	. . do . . .	28	44	58	49	35
Do	60128	41	. . do . . .	20	24	66	58	27
s-Triazine, 2,4-diamino-6-methoxy-	50984	.5	. . do . . .	6	24	100	70	34
s-Triazine, 2,4-diamino-6-(2-thienyl)-	60103	.25	Methanol . .	20	24	100	76	28
s-Triazine, 2,4,5-tri-2-pyridyl-, trihydrate	51067	.5	Water . . .	4	8	100	98	98
s-Triazole, 3-(methylamino)-5-phenyl-	62385	1	Methanol . .	18	38	34	59	59

See footnotes at end of table.

Table 3.--Chemosterilant activity and toxicity of compounds fed to mixed-sex boll weevil groups for 3 days--Continued

Chemical name	AI3-	Concen- tration (%)	Solvent	Mor- tality (%) at--	Total eggs collected (days)		Avg. egg hatch, days	Avg. adult emergence, days
					7	14		
4H-1,2,4-Triazole, 4,4'-[<u>(p-phenylene-</u> dimethylidene) diamino]di-.	62494	0.5	Acetone. . .	32	46	56	68	29
s-Triazolo-[1,5a]-s-triazine-5,7= (4H,6H)-dione, 5-thio-, compound with pyridine (1:1).	62555	.5	Water. . . .	22	30	100	96	26
Do.	62555	1	. . do . . .	46	66	28	88	25
Trimidazo[1,2-a:1',2'-c:1'',2'''-e]= s-triazine, 2,3,6,7,10,11-hexahydro- Do.	62569	.25	Methanol . .	18	22	100	70	46
Do.	62569	.5	. . do . . .	58	72	82	71	44
Do.	62569	1	. . do . . .	62	80	42	91	62
Trimethylamine, 1,1-bis(allyloxy)- Urea, 3-[(5-anilino)-1,3,4-thiadiazol= 2-yl]-1,1-dimethyl-.	61677	2.5	Water. . . .	100	---	0	---	---
Do.	62549	2.1	Acetone. . .	24	42	74	51	11
Do.	62549	2.5	. . do . . .	16	32	100	80	30
Urea, 3-[bis(dimethylamino)methylene]= 1,1-dimethyl-2-thio-.	62571	1	Water. . . .	40	56	72	64	33
Urea, 1-(2-chloroethyl)-3-cyclohexyl= 1-nitroso-.	52779	5.5	Acetone. . .	96	96	50	32	24
Do.	52779	4.5	. . do . . .	92	92	50	0	16
Do.	52779	5.1	. . do . . .	100	---	0	---	---
Do.	52779	4.1	. . do . . .	100	---	0	---	---
Urea, 1-(2-chloroethyl)-1-nitroso= 3-(2,6-xylyl)-.	52786	.01	Acetone. . .	88	96	29	71	0
Urea, 1-cyano-2-thio-, compound with diethylamine (1:1).	62326	1	Water. . . .	16	16	93	86	60
Urea, 3,3'-[4-(p-dimethylamino)- phenyl]-1,2,4-dithiazolidine-3,5= diylidene]bis[1,1-dimethyl-2-thio]- Urea, 1,1'-(4-phenyl-1,2,4-dithiazo- lidine-3,5-diylidene)bis[3,3-di- methyl-2-thio]-.	62574	1	Methanol . .	24	34	38	68	26
Do.	62537	.25	Water. . . .	2	6	100	82	34
Urea, 1,1,3,3-tetramethyl-2-seleno- Do.	61469	.5	. . do . . .	92	94	2	100	100

<u>Voacanga africana</u> stem bark, alcohol extract.	41548	2.5	Methanol . . .	46	54	52	54	31
Do.	41548	2.75	. . do . . .	12	18	60	53	18
2,5-Xylenesulfonamide, N-(2,4-dinitro-1-naphthyl)-	62757	1	Acetone. . .	98	98	0	---	---
2,5-Xylenesulfonamide, N-1-naphthyl-	62754	1	. . do . . .	0	0	100	80	34
Standards:								
Apholate		7.005	Water. . . .	10	19	52	14	6
Busulfan		8,9,1	Acetone. . .	9	15	57	4	33
Controls:								
None ¹⁰		---	Water. . . .	16	25	75	61	30
None ¹¹		---	Acetone. . .	19	26	87	63	31
None ¹²		---	Methanol . .	16	26	89	65	29

¹One-half of eggs held for hatch; 1/2 implanted for adult emergence.

²2 replications.

³Test ended early.

⁴Treated female mated to untreated male.

⁵Treated male mated to untreated female.

⁶3 replications.

⁷53 replications.

⁸21 replications.

⁹6-day treatment.

¹⁰78 replications.

¹¹74 replications.

¹²70 replications.

Finally, *m*-(salicylideneamino)phenol at 0.25 % to 0.5 % reduced fecundity of treated females by 50 % to 80 %.

Many other compounds effectively sterilized boll weevils but were too toxic at the test concentrations. Still other compounds, which seem to have no merit as chemosterilants, were very toxic at low concentrations and may well be tested as insecticides.

Inconsistencies in treatments may have occurred because of the repellent nature of certain compounds. For example, weevils may eat a diet containing 1 % of a chemosterilant and become sterile; yet a 2 % concentration of the same chemical may repel the weevils, and little or no feeding takes place.

LITERATURE CITED

- (1) Bartlett, A. C. 1967. Genetic markers in the boll weevil. *J. Hered.* 58: 159-163.
- (2) Borkovec, A. B. 1966. Insect chemosterilants, pp. 71-92. Interscience Publishers, New York.
- (3) Gast, R. T., and Davich, T. B. 1966. In C. N. Smith (ed.), *Insect Colonization and Mass Production*, ch. 27, pp. 4, 5, 18. Academic Press, New York.
- (4) Haynes, J. W., Mitlin, N., Davich, T. B., and Sloan, C. E. 1971. Evaluation of candidate chemosterilants for the boll weevil. U.S. Dep. Agric. Prod. Res. Rep. No. 120, 24 pp.
- (5) ———, Mitlin, N., Davich, T. B., Dawson, J. R., Woods, C. W., and Terry, P. H. 1972. Chemosterilants screened against the boll weevil in dipping and feeding tests. U.S. Dep. Agric. Prod. Res. Rep. No. 141, 21 pp.
- (6) Vanderzant, E. S., and Davich, T. B. 1958. Laboratory rearing of the boll weevil. A satisfactory larval diet and oviposition studies. *J. Econ. Entomol.* 51(3): 288-291.

